Bentley University
Data Management Plan

The investigators have developed a data management plan that embraces the overall NSF philosophy of data management and dissemination, the Division of Ocean Sciences Sample and Data Policy (NSF 17-037): *Principal Investigators (PIs) are expected to share with other researchers and the public, at no more than incremental cost and within a reasonable time, the data, samples, physical collections, and other supporting materials created or gathered in the course of work under NSF grants.*

In this proposal, the PIs agree to follow this policy throughout the project duration and beyond.

1. Types of Data

Data from this project fall into two broad categories: measurements made in the field, and those from laboratory analysis. Although all three PIs will be responsible for data collection and entry, Dr. Archer will be responsible for ensuring that all data are appropriately collected, entered, and stored.

Field Collections – Data collected in the field will be written on prepared waterproof data sheets. Data on field sheets will be photocopied while still on Abaco and then entered into digital spreadsheets on the day of collection or as soon as is reasonable given logistical constraints. R scripts will be developed to automate data quality control and quality assurance (QAQC). Specifically, these scripts will automatically detect outliers and randomly select 10% of newly entered data for manual re-checking against paper datasheets. Immediately following QAQC procedures, all data will be backed up daily onto three external hard drives (one per PI/Co-PI) and loaded into Dropbox daily for shared access to data. Video surveys will be saved on GoPro cameras and will also be uploaded to Dropbox and separate external hard drives. Additionally, the video survey data and metadata will be uploaded to a global database (Global FinPrint) which is a repository of remote underwater video survey data. The PIs, undergraduate researchers from Bentley University, and a graduate student from FIU will be responsible for data entry and archiving in the field. Dr. Archer (or an appointed data manager if Dr. Archer is not in the field) will ensure daily that data have been deposited into Dropbox.

Laboratory Analysis - Primary producers and fauna samples will be evaluated and processed as described in the project description while research efforts are on-going in The Bahamas. Biological samples collected during field sampling will be stored in a -20°C freezer until they are processed. All biological sample processing will occur on Abaco in the laboratory at Friends of the Environment. Voucher specimens of taxa collected during sampling will be preserved in 70% ethanol and permanently stored with a natural history collection. The preferred choice for voucher specimen storage is the National Museum of The Bahamas. If Bahamian customs allow, duplicate voucher specimens will be stored in the Gulf of Mexico Natural History Collection at LUMCON. The remainder of the data will be collected through the analysis of water (for nutrient content) at either The University of The Bahamas or LUMCON, depending on Bahamian customs restrictions at the time of sampling. The data gathered from water analysis will include soluble reactive phosphorus and bioavailable forms of nitrogen, NH_4^+ and NO_x^-. Data will be immediately checked for outliers immediately upon receipt from the responsible laboratory. After initial data checks, the data will be uploaded to Dropbox and backed up on external hard drives.

Data Collected from Field Course- Undergraduate students from Bentley, FIU, and LUMCON supervised and supported by Bentley University, (see RUI Impact Statement for further detail), will collect data on the abundance of primary producers and fauna in the study sites associated with this research. These data will be collected using prepared waterproof data sheets, and students will be

responsible for data entry into Microsoft Excel daily. Dr. Archer will use the R scripts described above to perform QAQC on these data and then will upload these spreadsheets into Dropbox daily during the course.

Curriculum Materials Generated for 360° VR videos- While in The Bahamas, the PIs will use 360° virtual reality (VR) cameras to capture imagery of nearshore systems for the development of virtual reality field content for the field course curriculum, which will be disseminated to undergraduate students from Bentley, FIU, and LUMCON, and to Bahamian high school students. Curricular materials for the field course videos will be developed in conjunction with Dr. Jon Ericson's Virtual Reality Lab at Bentley University (*see Letter of Collaboration*). General lab protocols for previous virtual reality content development similar to the proposed videos are already approved by Bentley's general counsel. These include safety procedures and mitigation strategies for managing adverse reactions to VR.

2. Data Format

The primary data storage format will be Microsoft Excel. The original data from GoPro video surveys, and 360° VR films will be in .mov format. Raw video will be stored on triplicate external hard drives, one stored at each institution.

3. Access to Data and Data Sharing Practices and Policies

Three main approaches will be used for data sharing. First, after QAQC of all data, we will create a shared data depository maintained by Dr. Archer using Dryad so that all three institutions (Bentley University, FIU, and LUMCON) have open access to our data. After manuscript publication, these data will be made available to the public. Second, we will provide our data to Friends of the Environment at the end of each field season. They will use our data to further conservation and resource management goals in nearshore seagrass beds (see main text Broader Impacts). Third, following NSF policy, complete data sets will be provided to NSF no more than 2 years after collection. The relevant office for our data storage will be The Biological and Chemical Oceanography Data Management Office (BCO-DMO). This is text from the Division of Ocean Sciences Sample Data Policy:

The BCO-DMO is the primary data management archive for the Biological Oceanography and Chemical Oceanography programs, as well as several associated special programs. When awards are initialized, investigators should immediately contact BCO-DMO and register their projects by submitting project metadata. For projects where data cannot be served by BCO-DMO, or where they are more appropriately served by other community data repositories, metadata should still be deposited in BCO-DMO with links to the other data repositories.

We commit to comply with all of these guidelines and policies.

4. **Policies for Re-Use, Re-Distribution**-All policies regarding re-use and re-distribution will follow guidelines of the BCO-DMO office. Any questions we have regarding re-use or re-distribution will be resolved with that office.
5. **Archiving of Data**-Long-term archives will include shared Microsoft Excel files in Dropbox, BCO-DMO databases, on Dryad, and in written publications. All original data sheets will be stored in fire-proof containers. All digital data sets will be stored long-term on at least 3 hard drives (1 per institution).